Effect of internal heat generation on Marangoni convection in a superposed fluid-porous layer with deformable free surface.

ABSTRACT

Linear stability analysis is applied to investigate the effect of internal heat generation on Marangoni convection in a two-layer system comprising an incompressible fluid-saturated porous layer over which lies a layer of the same fluid. The upper free surface is deformable and is subject to a general thermal condition, while the lower boundary is rigid and is fixed at a constant temperature (isothermal) or a constant heat flux. The Beavers-Joseph condition is employed at the interface and the Forchheimerextended- Darcy equation is employed to describe the flow regime in the porous medium. The linear stability theory and the normal mode analysis are applied and the resulting eigenvalue problem is solved exactly. For both the upper and lower boundaries fixed at a constant heat flux, the analytical asymptotic solution of long wavelength is obtained using regular perturbation technique. It is observed that the critical Marangoni number decreases with an increase in the dimensionless heat source strength. However, an increase of the Bond number and the decrease of the Darcy number will help to slow the process of destabilizing the system.

Keyword: Heat generation; Marangoni convection; Porous layer.